

What is claimed is:

1. A method of through-etching a substrate, the method comprising:
forming a buffer layer on a first plane of the substrate;
forming a metal layer on the buffer layer;
5 forming an etching mask pattern on a second plane opposite to the first plane; and
through-etching the substrate with the etching mask pattern as an etching mask.

10 2. The method of claim 1, further comprising forming a recess region on the first plane before forming the buffer layer on the first plane.

3. The method of claim 1, after through-etching the substrate, further comprising:

15 removing the etching mask pattern;
removing the metal layer; and
removing the buffer layer.

20 4. The method of claim 1, wherein the substrate is formed of a single-crystal silicon.

5. The method of claim 1, wherein the buffer layer is formed of silicon dioxide.

25 6. The method of claim 1, wherein the metal layer is formed of aluminum.

7. The method of claim 1, wherein through-etching the substrate is performed by deep reaction ion etching (DRIE).

30 8. A method of through-etching a substrate, the method comprising:
forming a recess region of a predetermined depth on a first plane of the substrate;

forming a first buffer layer on the first plane of the substrate having the recess region;

forming a first metal layer on the first buffer layer;

5 forming a first etching mask pattern on a second plane of the substrate opposite to the first plane, for exposing at least a portion of a region corresponding to the recess region; and

through-etching the substrate with the first etching mask pattern as an etching mask.

10 9. The method of claim 8, wherein forming the recess region on the first plane of the substrate comprises:

forming a second etching mask pattern on the first plane of the substrate;

etching a portion of the substrate with the second etching mask as an etching mask; and

15 removing the second etching mask pattern.

10. The method of claim 9, wherein the second etching mask pattern is a photoresist pattern.

20 11. The method of claim 9, wherein the second etching mask pattern is a stacked structure comprising a second buffer layer and a second metal layer.

12. The method of claim 8, wherein the first etching mask pattern is a photoresist pattern.

25 13. The method of claim 8, wherein the first etching mask pattern is a stacked structure comprising a third buffer layer and a third metal layer.

30 14. The method of claim 8, further comprising wet-etching the first buffer layer that is exposed by the through-etching of the substrate.

15. The method of claim 12, after through-etching the substrate, further comprising:
removing the first etching mask pattern that is the photoresist pattern;

removing the first metal layer; and
removing the first buffer layer.

5 16. The method of claim 13, after through-etching the substrate, further comprising:

removing the third metal layer of the first etching mask pattern and the first metal layer; and

removing the third buffer layer of the first etching mask pattern and the first buffer layer.

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17. The method of claim 8, wherein the substrate is formed of a single-crystal silicon.

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18. The method of claim 8, wherein the buffer layer is formed of silicon dioxide.

19. The method of claim 8, wherein the metal layer is formed of aluminum.

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20. The method of claim 8, wherein through-etching the substrate is performed by DIRE.

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21. The method of claim 8, wherein a portion of the substrate which is penetrated by the through-etching of the substrate comprises the recess region.